PATENT SPECIFICATION 1,175,274

NO DRAWINGS.

Inventors:—DEREK ANTHONY GRAHAM and JOHN FRANCIS HOBBS.

1,175,274

Date of filing Complete Specification: 14 June, 1968.

Date of Application (No. 30777/67): 4 July, 1967.

Complete Specification Published: 23 Dec., 1969.

Index at acceptance:—F3 A(2C, 2D); B5 A(1R14C2, 1R58, 1R59, 1R100).

International Classification:—F 42 b 11/00.

COMPLETE SPECIFICATION.

Improvements in Bullets.

We, IMPERIAL METAL INDUSTRIES (KYNOCH) LIMITED, a British Company, of Kynoch Works, Witton, Birmingham 6, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to frangible bullets.

Frangible bullets have been proposed for a variety of purposes in which there are possible hazards resulting from ricocheting. Typical examples of these purposes are bullets for shooting galleries and bullets for animal slaughter for food production. The frangibility of these bullets is intended to ensure that gallery bullets will disintegrate on impact rather than ricochet, and animal slaughter bullets will break up rather than emerge from an animal being slaughtered as a potentially lethal missile.

However, it has been found that frangible bullets suffer from the need to be a compromise between opposed requirements; the bullets must be adequately frangible in order to keep hazards from ricocheting as low as possible, but they must also be of adequate strength to enable them to be handled from their initial manufacture right through their use at least until they emerge from a gun muzzle. Consequently, although many attempts have been made to come to the ideal compromise, they have been of relatively limited success.

This compromise between fragibility and handling strength is met in particular in bullets for shooting galleries. When used in shooting galleries, the bullets ideally are strong enough to be handled and to be fired to arrive at the target intact, but frangible enough to break up to a large degree on impact in order to prevent ricocheting of the whole bullet or substantial parts of it, perhaps causing injury to the shooter or other spectators, for example the gallery attendant.

In addition, for shooting galleries it is also desirable to use bullets which are lead-free because of the toxic effect of lead particles in the air, particularly if there is a long time of exposure, such as that experienced by the attendant. Also for animal slaughter, frangible bullets should be lead-free to avoid the toxic effects of lead on the meat consumer.

Accordingly it is an object of the invention to provide a frangible lead-free bullet which has good frangibility together with adequate strength for handling purposes.

In accordance with the invention a frangible lead-free bullet comprises, as the sole metal or metals, zinc powder or iron powder or a mixture of zinc and iron powders bonded together by 0.10 to 1.5% by weight of the weight of the metal content of the bullet of a cured thermosetting resin.

The percentage of thermosetting resin to be used depends upon several factors of which the first is the maximum quantity of resin which can be used without surplus resin exuding from the body of the bullet during curing of the resin. Thus the maximum is about 1.5% by weight of the weight of the metal content of the bullet and this will result in a strong bullet with a frangibility which is probably adequate for most purposes. The minimum amount of resin is the quantity which will hold the particles together to permit some careful handling,

and this is the 0.10% by weight. With such a resin content, excellent frangibility is achieved. A further factor is the intended purpose for the bullet, i.e. the particular compromise chosen between fragibility and strength. Thus, preferably there is about 0.9—1.25% by weight of the thermosetting resin if the bullet is intended to have sufficient strength to withstand severe handling. Where frangibility is the predominating requirement there may be 0.2—0.5%, preferably 0.25%, by weight of the thermosetting resin.

Preferably also the powder is provided with a lubricant to facilitate pressing and reduce tool scoring and other manufacturing difficulties. Graphite has been found to be suitable, and if graphite is used, there is preferably between 0.25—5% by weight of the weight of the metal.

Preferably further the thermosetting resin is provided with a plasticizer, and the resin may be an epoxy resin.

In accordance with the invention also, a method of manufacturing a frangible lead-free bullet comprises mixing zinc powder or iron powder or a mixture of zinc and iron powders with a solution of a thermosetting resin containing 0.10—1.5% by weight of the weight of the metal content of the mixture of the thermosetting resin, evaporating the solvent, pressing the mixture in bullet moulds and curing the resin.

Typical examples of the invention will now be more particularly described.

Example 1

In this example of the invention a lead-free bullet is produced by taking relatively fine zinc powder which has a particle size as follows, using the British Standard Specification No. 410:—

Range of Mesh Sizes	*% by weight of powder falling in range*
From 30 to 52	10
„ 52 to 60	15
„ 60 to 72	15
„ 72 to 100	20
„ 100 to 200	15
„ 200 to 300	15
Less than 300	10
	100%

The powder is mixed with a solution of 9gms of the epoxy resin available as 'Araldite AT1' from CIBA (A.R.L.) Ltd. and 1gm of a plasticizer such as tritolyl phosphate in 150cc of acetone at room temperature. ("Araldite" is a registered Trade Mark). The amount of solution used relative to the zinc powder is adjusted to provide 1% by weight of resin plus plasticizer relative to the zinc powder.

The mixing is carried out in a steam-heated barrel which evaporates the acetone solvent and leaves a very thin coating of the resin and the plasticizer on each particle of zinc powder. This results in some caking together of the zinc powder particles, but after evaporation of all the solvent, the resulting lumps are readily broken up and the coated powder is meshed and is mixed with approximately 2wt.% of the metal content of graphite to give some lubrication to the coated zinc powder. In an alternative method of mixing, the graphite is mixed with the acetone solution of resin and plasticizer, and the whole added to the barrel together.

The coated and lubricated powder is then pressed in bullet moulds which gives enough green strength for handling before curing. Curing is carried out in batches at about 2000°C for about one hour, but the curing time and temperature obviously depends upon the thermosetting resin which is chosen, and will normally be at between 250°C and 160°C for 10 minutes to 3 hours, respectively.

The resulting bullets were found experimentally to have good strength to enable them to be handled and to be fired, and adequate frangibility for their intended purpose as "cattle killer" bullets for animal slaughter. This results from the selection of a thermosetting resin as the binding agent for the zinc particles.

Example 2

In this example of the invention experimental bullets were manufactured generally in accordance with the method recited in Example 1, but containing only about 0.25% by weight of the weight of the metal content of the epoxy resin. It will be appreciated that these bullets have a much higher frangibility, as they are intended for use where the service conditions are such that a reduction in handling strength is desirable to achieve an increase in frangibility.

Example 3

In Examples 1 and 2, zinc powder alone was used because it is thought that there will then be less wear upon the machinery used both for mixing and particularly for pressing the powder in the bullet moulds. However, for reasons of economy, it may be preferable to use a mixture of zinc and iron powder, where a greater wear on the machinery can be tolerated. Thus, in Example 3, the same manufacturing route as that described in Example 1 is used, but iron powder with the same mesh sizes as described in Example 1 is used with the zinc powder in a blend of

80% by weight zinc powder and 20% by weight iron powder.

Example 4

In this example the same manufacturing route as that of Example 1 is used with a blend of 50% by weight zinc powder and 50% by weight iron powder.

Example 5

In this example the same manufacturing route as that of Example 1 is used with a blend of 20% by weight zinc powder and 80% by weight iron powder, or with iron powder alone.

WHAT WE CLAIM IS:—

1. A frangible lead-free bullet comprising, as the sole metal or metals, zinc powder or iron powder or a mixture of zinc and iron powders bonded together by 0.10 to 1.5% by weight of the weight of the metal content of the bullet of a cured thermosetting resin.

2. A bullet according to claim 1 wherein the weight of the thermosetting resin is from 0.9 to 1.25% of the weight of the metal content of the bullet.

3. A bullet according to claim 1 wherein the weight of the thermosetting resin is from 0.2 to 0.5% of the weight of the metal content of the bullet.

4. A bullet according to any one of the preceding claims further comprising 0.25 to 5% by weight of the weight of the metal content of the bullet of graphite.

5. A bullet according to any one of the preceding claims wherein the thermosetting resin is provided with a plasticizer.

6. A bullet according to any one of the preceding claims wherein the thermosetting resin is an epoxy resin.

7. A bullet according to claims 5 and 6 wherein the plasticizer is tritolyl phosphate.

8. A bullet according to any one of the preceding claims wherein the metal content of the bullet is solely zinc powder.

9. A bullet according to any one of claims 1—7 wherein the metal content of the bullet is solely iron powder.

10. A bullet according to any one of claims 1—7 wherein the metal content of the bullet is a blend of 80% by weight zinc powder and 20% by weight iron powder.

11. A bullet according to any one of claims 1—7 wherein the metal content of the bullet is a blend of 50% by weight zinc powder and 50% by weight iron powder.

12. A bullet according to any one of claims 1—7 wherein the metal content of the bullet is a blend of 20% by weight zinc powder and 80% by weight iron powder.

13. A method of manufacturing a frangible lead-free bullet comprising mixing zinc powder or iron powder or a mixture of zinc and iron powders with a solution of a thermosetting resin containing 0.10 to 1.5% by weight of the weight of the metal content of the mixture of the thermosetting resin, evaporating the solvent, pressing the mixture in bullet moulds and curing the resin.

14. A method according to claim 13 wherein the thermosetting resin is an epoxy resin and curing is effected at 250 to 160°C for between 10 minutes and 3 hours.

15. A method according to claim 14 wherein the epoxy resin is cured at about 200°C for about one hour.

16. A frangible lead-free bullet when made by the method substantially as described in Example *1* herein.

17. A frangible lead-free bullet when made by the method substantially as described in Example *2* herein.

18. A frangible lead-free bullet when made by the method substantially as described in Example *3* herein.

19. A frangible lead-free bullet when made by the method substantially as described in Example *4* herein.

20. A frangible lead-free bullet when made by the method substantially as described in Example *5* herein.

21. A method of manufacturing a frangible lead-free bullet substantially as described in Example *1* herein.

22. A method of manufacturing a frangible lead-free bullet substantially as described in Example *2* herein.

23. A method of manufacturing a frangible lead-free bullet substantially as described in Example *3* herein.

24. A method of manufacturing a frangible lead-free bullet substantially as described in Example *4* herein.

25. A method of manufacturing a frangible lead-free bullet substantially as described in Example *5* herein.

M. A. KERR,
Agent for the Applicants,
Chartered Patent Agent.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1969.
Published at The Patent Office, 25 Southampton Buildings, London, W.C.2,
from which copies may be obtained.